SCOTTISH QUALIFICATIONS AUTHORITY

Principal Assessor Report 2003

Assessment Panel:	**Engineering**

Qualification area

Subject(s) and Level(s) Included in this report	**Mechatronics: Higher**

Statistical information: update

Number of entries in 2002	
Pre appeal	26 from 4 centres

Number of entries in 2003	
Pre appeal	33 from 5 centres (5 centres linked to 3 FE Colleges)

General comments re entry numbers

In the first four years of the qualification there has been a steady growth in both numbers of candidates and presenting centres. This growth continues to be encouraging particularly in light of the ongoing difficult engineering sector situation which remains problematic owing to both local and global factors in Technology and Manufacturing.

There were three FE Colleges of which two had teaching links with two local secondary school partners. This enabled candidates from the local secondary school to study within the FE College in addition to the college's more traditional FE full time NC candidates.

An additional 16 candidates from 3 centres were absent on the day of the examination although they had been registered for it.

Grade boundaries at C, B and A for each subject area included in the report

The grade boundaries for 2003 were as follows:

Upper A = 85%
Lower A = 70%
B = 60%
C = 50%

Standardised 'a priori' Grade Boundaries were set.

General commentary on passmarks and grade boundaries

- While SQA aims to set examinations and create mark schemes which will allow a competent candidate to score a minimum 50% of the available marks (notional passmark) and a very well-prepared, very competent candidate to score at least 70%, it is almost impossible to get the standard absolutely on target every year, in every subject and level
- Each year we therefore hold a passmark meeting for each subject at each level where we bring together all the information available (statistical and judgmental). The Principal Assessor and SQA Qualifications Manager meet with the relevant SQA Business Manager and Statistician to discuss the evidence and make decisions. The meetings are chaired by members of the senior management team at SQA
- We adjust the passmark downwards if there is evidence that we have set a slightly more demanding exam than usual, allowing the pass rate to be unaffected by this circumstance
- We adjust the passmark upwards if there is evidence that we have set a slightly less demanding exam than usual, allowing the pass rate to be unaffected by this circumstance
- Where the standard appears to be very similar to previous years, we maintain similar grade boundaries
- An exam paper at a particular level in a subject in one year tends to have a marginally different set of grade boundaries from exam papers in that subject at that level in other years. This is because the particular questions are different. This is also the case for exams set in centres. And just because SQA has altered a boundary in a particular year in say Higher Chemistry does not mean that centres should necessarily alter boundaries in their prelim exam in Higher Chemistry. The two are not that closely related as they do not contain identical questions
- Our main aim is to be fair to candidates across all subjects and all levels and maintain standards across the years, even as syllabuses evolve and change

Comments on grade boundaries for each subject area

A number of issues were raised during marking and in subsequent discussions about Question 9 (b), Question 12 (d) and Question 12 (e). Further details are given below. The overall conclusion was that NO adjustment was needed.

Question 9 (b) dealt with control systems' responses to Proportional (P) and Proportional + Derivative (PD). The question asked candidates to "… sketch and label the output responses …". The Scrutineer pointed out that "… system responses depend on process dynamics and controller gain value…" of which the markers were also aware. The area is a complex one and the treatment within the course remit is quite restricted and simplistic though entirely appropriate for the level being taught and assessed. This issue was discussed by central markers and the key elements that were sought were identified. Parts (i) and (ii) were marked collectively and the question showed considerable discrimination between candidates generally in line with their overall ability and knowledge. No adjustment was therefore needed though the format of the question for future years will be considered at setting meetings to seek to remove more of the elements of possible uncertainty.

Question12 (d) asked for a system and required a response that ought to be "… including the logic decision required to be made by the system." The Scrutineer pointed out a potential weakness as to what was required but setters and the Principal Assessor considered it a reasonable part of this question. Candidate responses were not very good for this part of the question though better than for Question 12 (a) (ii) (which should have been a fairly simple knowledge recall answer). Quite a few candidates achieved 2 out of the 3 available marks though more who tackled Question 12 got no marks. If it did disadvantage a candidate then it was likely that the maximum effect would be 1 mark but after discussion it was decided that there was insufficient evidence for disadvantage. Issues raised would be re-discussed at the setting/vetting meetings.

Question 12 (e) asked how something could be controlled in a system. The intention was to have two aspects being controlled – the two being "pressure applied" and "time – the 10 seconds necessary to cure the adhesive". However, at the Central Marking, on reading candidate responses it was evident that whilst some candidates were supplying a two-fold answer, others were supplying EITHER one OR the other – but not both! The question was re-read carefully and it could be seen how candidates could legitimately believe that ONLY ONE aspect was asked for rather than the two intended. It was therefore agreed that candidates could NOT be penalised for supplying an answer that dealt with only one aspect (either pressure or time). So the 2 marks were available for either or both aspects. This potentially might advantage candidates by up to 1 mark but many candidates did supply answers which covered both aspects and for those who didn't they often supplied a fuller answer than if both had been covered. Therefore no adjustment was made for this issue.

Comments on candidate performance

General comments

This year saw the continuation of a wide range of candidate ability. There were some candidates of excellent ability from more than one centre and some others of limited ability, who lacked knowledge or were ill-prepared. Encouraging, once again, for the centres (and the setters) is the fact that the top candidates came from a variety of centres with the top six performers (all achieving over 83 marks) coming from four different centres. The lowest five (who all achieved less than 30 marks) all came from one centre but the next lowest six came from four centres.

The most able candidates showed a very good grasp of the subject with seven candidates (about 21% of candidates) achieving 80% or above and the top candidate 92 (the same as last year). The markers commented that for these candidates the answers given were in some cases almost 'model answers' and they themselves would be unlikely to do better under examination conditions.

The Section A questions are mandatory and tested a wide range of topics with only a portion having more stretching parts. The Section B of the paper provided more integration in assessment and also stretched candidates more. In Section B often the particular scenario and issues presented in the examination will almost certainly have never been seen by the candidate before. Excellent performance here clearly shows candidates possessing a well developed grasp of both the principles and application of the subject which requires not only knowledge of standard elements but the ability to understand and problem solve on novel systems.

Overall there were areas of weakness but there was no major area of the subject where all candidates were failing either through not answering or providing incorrect responses.

Last year it was commented that "What is less obvious from the tabular information is the fact that, of those who failed to gain an award (38.5% in 2002) there were no 'near misses'. This trend is still evident with the 39.4% failing to gain an award generally performing quite poorly. The highest marks amongst the 'No award' candidates were one candidate with marks of 48%, one with 45% and one with 44%.

Also the lowest C achieved a mark of 53. This shows there is a large 'gap' in the middle between successful and unsuccessful candidates – anecdotal evidence from centres suggests that this is the case where certain candidates are very interested and/or have a natural ability or flair for the subject whilst the other group are less able, less motivated and/or struggle with the complex nature and systems approach of this technology rich subject.

Areas of external assessment in which candidates performed well

The following questions or part questions were generally well answered by most candidates who attempted them, at most centres (>66% average mark achieved for all candidates who attempted):

Question 1 (a), Question 1 (b), Question 2, Question 3 (a), Question 4, Question 7 (c) (i), Question 8 (b), Question 11 (a), Question 13 (c), Question 13 (d).

These covered:

Changing of controlling actions/advantages, microcontroller block diagrams, editors, code systems and codes, types of robots and their programming, examples of particular type of sensor, disk encoder calculations, PLC and microcontroller I/O allocations, suggesting safety features.

It was particularly pleasing to see the important area of SAFETY was quite well covered as in real life this must always be kept in a practitioner's mind.

See also comments in the Feedback to centres section as regards responses.

Areas of external assessment in which candidates had difficulty

The following questions or part questions were generally NOT well answered by most candidates who attempted them, (<35% average mark for all candidates who attempted question or part question).

Question 6 (b), Question 8 (a), Question 11 (d), Question 12 (a) (ii), Question 12 (d)

These covered:

Resolution of digital signal, optical incremental encoder operation, adding to PLC ladder diagram including timers, work envelope of SCARA robot, sensing system and logic decision.

See also comments in the Feedback to centres section as regards responses.

Recommendations

Feedback to centres

Generally all centres except one demonstrated, via their candidates, that they had covered the required subject areas.

Regarding well answered questions these included 1, 2, 3, 4, in section A. Not very well answered questions included 6 and 5 (some centres), 9 and 10 (some centres) in Section A.

Once again, approximately equal numbers of candidates answered each of the three optional questions in Section B (21 v. 22 v. 22) which suggests no weakness or aversion to any of three areas/approaches represented there (and hopefully equality of hardness of question as perceived by the candidates). Performance in each question was also fairly well balanced when the averages are compared (Question 11 = 45% of available marks, Question 12 = 43%, Question 13 = 58%) though these figures hide some 'textbook exemplar' responses (> 90% of available marks) from a number of excellent candidates with responses for Question 13 being particularly good in general.

Only one candidate out of 33 failed to answer two Section B questions though a number of poorer candidates gained very few marks for answers. Also quite a number of candidates either did not attempt all Section A questions or failed to gain any marks for a particular question. Some candidates submitted more than the two required Section B questions. The SQA marking instructions allow for this in that markers can mark all three questions and then choose to retain the highest two marks and discard the lowest. This can prove useful for very strong candidates who have time to spare having completed the paper and also for very weak candidates who may be less sure of answering all the parts of a Section B question or whether they have really provided the required content.

Occasionally answers were seen in which the volume and depth of response was vastly different (too little or too much) for the available marks. Candidates should be trained to tailor and size their answers to take account of the available marks (eg a 1 mark question asking to 'state' something is unlikely to need several lines of discussion/description).

Writing was generally legible (though a few could have written larger) and the diagrams were quite good and appropriate for the timed situation though there was considerable variation in comprehensiveness. Spelling was interesting at times but not penalised where understandable.

Once again, switching between workbook and worksheet appeared to cause no problems to candidates with only a few minor transgressions noted in the placing of answers. (However, markers requested less transitions if possible to ease their shuttling back and forth).

Time management in answering the paper appeared generally good with more evidence of running out of answers/valid responses than running out of time.

Candidates who did not achieve a pass failed to do so by a considerable margin. So there was quite a gap between the successful and unsuccessful candidates. It should be remembered that unsuccessful candidates who achieved all the continuously assessed units can re-take the external examination at a future presentation to gain the full award. Centres should consider reviewing their admissions and progression policies to ensure candidates are not being entered for assessments beyond their capability. The lowest overall marks were less than 20% (two candidates) which showed little evidence of appropriate knowledge and understanding. To boost the performance of this under-performing group it is likely that extra work with candidates will be needed.

Overall 16 further registered candidates failed to sit the examination – if they do not already know, centres should determine the reasons for this high level of absenteeism.

Finally, from the marked scripts, and particularly the evidence from the better candidates, staff within centres should continue to be encouraged by, and commended for, the quality and depth of understanding being demonstrated by candidates. This is particularly true in the technology rich area of mechatronics, where candidates rarely have had any relevant previous knowledge or experience of the subject prior to joining the course. Well done.

A question by question feedback follows – comparatives refer to how well candidates responded.

Question 1 (a) better than (b) which was much better than (c). So ASIC a weakness.

Question 2 generally quite good.

Question 3 (a) better than (b). Part (b) Gray and – either candidate knew it well or not at all.

Question 4 well answered though (c) weaker.

Question 5 About half of candidates knew this and usually got 100%, the rest did not know and got 0%.

Question 6 (a) many candidates considered digital to simplistically have "two levels" only which lost marks. (b) was well answered if candidate knew the answer.

Question 7 (a) provided good discrimination with a range of marks being awarded. (b) was not well answered with considerable confusion. (c) was quite poor for the practical aspects and application.

Question 8 (a) either candidate knew it well or not at all. (b) Most candidates answered this well if they knew it.

Question 9 (a) either candidate knew it well or not at all. (b) Some good answers but many candidates were confused about this area.

Question 10 quite well answered overall. Candidates tended to give very good or very poor responses.

Question 11 (a) to (d) were increasingly challenging to candidates with marks overall falling from 75% down to 22%. (e) was well answered generally, (f) and (g) were generally OK.

Question 12 (a) part (i) was OK but (ii) was very poor (iii) much better. (b) was quite well answered with (c), and (d) increasingly less well answered. (e) and (f) were quite well answered.

Question 13 (a) and (b) were generally quite well answered. (c) and (d) were well answered with most candidates getting good marks. (e) and (f) were often good attempts though there were some very poor and simplistic attempts with large 'multifunction' boxes.